Remarks

Entry of this Amendment, reconsideration of the Application, and allowance of the claims are respectfully requested. Claims 6, 14, 22 and 41 are amended, with claims 14 and 41 being placed into independent form here, and claims 51-64 are added. Claims 7 & 23 are canceled without prejudice; and claims 25-31 are "formally" canceled (again without prejudice), as they were withdrawn from consideration in an earlier May 1, 2002 Office Action due to restriction issues. Therefore, claims 1, 3-6, 8-18, 21, 22, 24 and 41-64 are pending; including independent claims 1, 14, 18 and 41.

In accordance with 37 C.F.R. 1.121(c)(1)(ii), a marked-up version of the amended claims is provided on one or more pages separate from the amendment. These pages are appended at the end of the Response.

Three additional Figures (8-10) are also added to the Application, along with a specification amendment to page 8. These amendments adopt, virtually identically and verbatim, the following subject matter from incorporated U.S. Patent Application no. 09/667,966 (now U.S. Patent No. 6,285,506): column 3 lines 21-51; column 4 lines 59-67; claims 1, 2, 10, 12, 13. This subject matter is also the subject of new claims 51-64, directed to the structure of one exemplary doubly-curved x-ray optic. Since this subject matter was referred to repeatedly in this Application, and incorporated by reference at page 3, line 16, no new matter is added and Applicant respectfully requests entry of these amendments.

Applicant gratefully acknowledges the indication of allowability of claims 14-17 and 41-48. In response, claims 14 and 41 are both amended into independent form to include the features of their base claim 1. An indication of full allowance of these claims is now respectfully requested.

In the Office Action, claims 1, 3-7, 9, 10-13 and 18-24 were rejected under 35 U.S.C. 103(a) as obvious over Wittry (USPN 5,892,809) in view of Ohsugi (USPN 5,249,216); and claims 8, 49 and 50 were also separately rejected over this combination. Applicant respectfully

traverses these rejections on the following grounds: (1) The Office Action has misinterpreted the teachings of the base document Wittry thus voiding the underlying basis of this rejection; (2) the justification for combining the documents is deficient; (3) the documents themselves lack any teaching, suggestion or incentive for their combination; and (4) the combination is a hindsight reconstruction of the clamed invention using Applicant's own disclosed subject matter.

First, the Office Action alleges that Wittry teaches a "total-reflection x-ray fluorescence system" at col. 5, lines 24-26. Applicant strenuously traverses this characterization of Wittry. As discussed in detail in Applicant's August 2002 Response, the expression "total-reflection x-ray fluorescence" (commonly abbreviated TXRF) is a term of the art. As described in Applicant's own Background of the Invention, TXRF is a specific analytical method in which x-rays are directed upon an optically reflective surface and are "totally" reflected with little or no surface scatter. TXRF is characterized by very low angles of incidence – usually referred to as grazing angles, of less than one (1) degree. TXRF is concerned with the claimed detection of foreign matter present on the surface.

A simple review of other TXRF documents and their drawings easily confirms this:

> USP 5,742,658 to Tiffin (cited in a prior Office Action) col. 3 lines 13-30 (" ... a relatively new EDXRF **surface** analysis technique known as **total reflection** x-ray fluorescence (TXRF) ... an angle of incidence is very **small** ... typically less than **.2 degree** ...").
>
> USP 5,249,216 to Ohsugi (cited originally by Applicant and also in the instant Office Action) col. 1 lines 8-10 ("... trace analysis of particles located near a surface such as **surface contaminations** by **total reflection** x-ray fluorescence ... **small** glancing angle ...") col. 4 line 41 ("... **.06 degree** ...").

Applicant's independent claims 1 and 18 recite TXRF, which is concerned with the claimed detection of foreign matter present on the surface.

In contrast to this claimed invention, Wittry contains no teaching or suggestion of TXRF or surface analysis. Indeed, neither the cited pages of col. 3 nor the drawings disclose TXRF or the small glancing angles characteristic of TXRF. Certainly, the drawings all show much larger

angles of incidence which is characteristic of standard XRF, not TXRF. Wittry is, in fact, not directed to this claimed TXRF apparatus, or the claimed detection of "foreign matter on the surface." Rather, Wittry is directed to standard, internal elemental analysis of the sample: col. 7, lines 12-20 ("... good coverage of elements in the periodic table ... enhances the detection of some of the **elements** of particular interest as dopants **in** semiconductor devices ...").

Applicant respectfully submits that this misinterpretation of Wittry undercuts its viability as a primary reference, rendering the rejection improper on this basis alone.

Second, Applicant strenuously traverses the reasoning justifying the combination of Wittry and Ohsugi. The only justification given for the combination is the following language at the bottom of page 3 of the Office Action:

> It would have obvious ... [that] the surface of the sample of the total reflection x-ray fluorescence apparatus as disclosed by Wittry could be modified to incorporate a semiconductor wafer having an optical reflection surface as disclosed by Ohsugi. Accordingly the motivation is the resultant structure will be utilized in analyzing surface contamination on the surface of a semiconductor wafer, thereby, reducing the cost of manufacturing semiconductor wafers by testing a number of wafers to determine if any particles are located on the surfaces of the semiconductor wafers.

Noticeably absent from this justification is any express teaching, suggestion or incentive identified in the art for making the proposed combination. Just as in Winner International Royalty Corp. v. Wang, 48 U.S.P.Q. 2d 1139, 1144 (D.C. 1998), wherein the Court overturned a Board finding of obviousness, hindsight is always perfect and it is insufficient to prove at the time of the claimed invention, the separate elements of the device were present in the known art. "Rather, there must have been some explicit teaching or suggestion in the art to motivate one of even ordinary skill in the art to combine such elements so as to create the same invention." Id. Winner's cited authority, Arkie Loures Inc. v. Gene Larew Tackle Inc., 43 U.S.P.Q. 2d 1294, 1297 (Fed. Cir. 1997), similarly holds that:

> It is insufficient to establish obviousness that the separate elements of the invention existed in the prior art, absent some teaching or suggestion, in the prior art, to combine the elements.

This justification does not identify a teaching, suggestion or incentive in the art to combine these references as required by cases like Winner and Arkie. This justification is simply a restatement of the results of the combination, rather than a reason for the combination drawn from the prior art or from the knowledge available to one of ordinary skill in the art.

Third, upon an independent review of these documents, there is no teaching, suggestion or incentive for their combination. In fact, as discussed above in detail, Wittry is not a TXRF reference at all. Since the Wittry document is not even in the TXRF field of the present invention or Ohsugi, one of ordinary skill would not find a suggestion for the combination proposed here. Other fundamental differences exist between these documents themselves, and the claimed invention.

For example, Ohsugi does not disclose any input beam focusing, as discussed at page 2 of the present Application – Ohsugi is in fact devoid of any discussion regarding the excitation beam profile. Therefore, Ohsugi does not and could not discuss any input focusing optics, especially of the type disclosed and claimed in the present Application.

Fourth, since this justification offers no technical basis outside that contained in Applicant's own specification, and merely restates the results of the combination in hindsight, this rejection also violates the well-known principle that an Applicant's own disclosure cannot be used as a reference against him.

The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that the claimed invention should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art. Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure. In re Dow Chemical Co. 5 U.S.P.Q. 2d 1529, 1531 (Fed. Cir. 1988) (multiple citations omitted). The combination simply restates the result of the combination, and is therefore using Applicant's disclosure, rather than an identified basis in the prior art, to combine the documents, in violation of this well known principle. This is yet another, independent reason why the current invention is not obvious.

In summary, Applicant traverses this rejection of independent claims 1 and 18, based on a misinterpretation of the base reference Wittry; the conclusory nature of the reason for combination; the lack of an actual teaching, suggestion or incentive in the art for the combination; and the use of Applicant's own disclosure and results as a basis for the combination.

Dependent Claims:

The dependent claims are patentable for the same reasons discussed above, as well as for their own additional features.

For example, claim 6 and amended claim 22 both recite one or more apertures for limiting the convergent angle of the diffracted x-rays. Since the x-ray optic produces the diffracted x-rays, these claims necessarily require that the aperture is placed after the x-ray optic. Dependent claims 49-50 both positively recite placement after the optic. These features are shown clearly in Applicants' Figure 1. As discussed at page 9 of the Application: "The aperture produces a convergent angle in the dispersion plane for the diffracted x-rays which is less than the critical angle of incidence for the surface to ensure the total reflection of the x-rays from the optical reflection surface for the wavelength of the x-rays." This type of aperture is, therefore, important for limiting the angle of incidence required in Applicants' claimed TXRF system.

To remove any ambiguity regarding placement of the aperture, claims 7 and 23 (which recite placement before the optic) have been canceled herein; and claims 6 and 22 have been amended to recite that the angle onto the surface is limited by the claimed apertures.

Applicant strenuously traverses the Office Action's interpretation of Wittry and Uhsughi against the remaining claims:

> Wittry's "apertures": Pages 3 and 4 of the Office Action apply element "27" and column 6 of Wittry. However, these apertures are not the same as those claimed by Applicant. Wittry's aperture 27 is for the electron beams, not x-rays, in Wittry's source. His

apertures exist in the electron beam column, before the x-rays are even produced by Wittry's target assembly 31, and certainly not after Wittry's diffractors 8-12. Wittry's apertures therefore have no impact on the diffracted x-ray incident angle, as claimed. Moreover, shield 73 of Wittry does not limit the convergent angle, but is simply a protective shield against x-ray scattering. Wittry's standard XRF teachings (discussed in detail above) in fact teach away from limiting a convergent angle since standard XRF is not concerned with limiting incident angles, as is the claimed TXRF.

Ohsugi's "apertures": Page 4 of the Office Action applies Ohsugi's "slit" 5 and column 8 lines 18-21. This slit is, however, part of the detection system after the sample, and therefore does not limit the convergent angle of the diffracted x-rays produced by the x-ray optic as claimed. Moreover, Ohsugi's slit 2 is placed before the x-ray optic, not after the x-ray optic, as claimed.

In combination with Applicant's doubly-curved optic of the independent claims, the apertures of these dependent claims further lit the incident angle onto the surface, which is critical in TXRF systems. Since neither Wittry nor Ohsugi teach an aperture following a doubly-curved optic, Applicant respectfully submits that claims 6 and 22, along with their further limiting claims 49 and 50 are patentable. In fact, these claims are patentable even assuming, arguendo, that the combination proposed by the Examiner is proper, because of the complete absence of any teaching or suggestion of these claims in either document.

Withdrawal of these obviousness rejections is therefore respectfully requested.

New Claims:

New claims 51-64 are added herein, and are supported by the specification and drawing amendments discussed above. These dependent claims are directed to a particular embodiment of the claimed doubly-curved x-ray optic of the present invention, as set forth in Applicant's U.S. Patent Application no. 09/667,966 (now U.S. Patent No. 6,285,506). This subject matter was referred to by application number throughout the present application and therefore no new matter is added. In fact, these dependent claims are of a similar structure to the claims issued in that patent.

Applicant respectfully submits that these dependent claims are patentable for the same reasons discussed above regarding their respective independent claims, as well as for their own additional features. None of the cited documents disclose, teach or suggest this type of doubly-curved optic, with a thin optical layer and a thick epoxy layer, allowing a de-coupling of the profiles of the optical layer and the structural, backing layer. Entry of these claims and allowance thereof are respectfully requested.

In view of the above Amendments and Remarks, allowance of all claims is respectfully requested. Applicant's attorney is available at the number listed below should any questions arise.

Respectfully submitted,

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Dated: January 31, 2003

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Marked-Up Version of Claims

In the Claims:

Claims 7, 23 & 25-31 have been canceled without prejudice.

Claims 6, 14, 22 and 41 have been amended and new claims 51-64 have been added as set forth below:

6. (Once Amended) An apparatus as recited in claim 1, further comprising one or more apertures for limiting a convergent angle onto the surface of the diffracted x-rays, wherein the convergent angle comprises the angle subtending the upper and lower extents of the diffracted x-rays.

14. [An apparatus as recited in claim 1,] A total-reflection x-ray fluorescence apparatus comprising:

an x-ray source for providing x-rays;

a doubly-curved x-ray optic for diffracting and focusing the x-rays provided by the x-ray source;

a surface onto which at least some of the diffracted and focused x-rays are directed;

an x-ray detector for detecting resulting x-ray fluorescence emitted by any foreign matter present on the surface; and

wherein the locations of the doubly-curved x-ray optic, x-ray source, and point of impingement upon the surface define an optical circle of radius R wherein the doubly-curved x-ray optic has an optic surface of radius 2R and one or more atomic planes essentially parallel with the optic surface.

22. (Once Amended) A method as recited in claim 18, further comprising passing the diffracted x-rays through at least one aperture to limit the convergent angle onto the surface of

the diffracted x-rays, wherein the convergent angle comprises the angle subtending the upper and lower extents of the diffracted x-rays.

25. Canceled.

26. Canceled.

27. Canceled.

28. Canceled.

29. Canceled.

30. Canceled.

31. Canceled.

41. [An apparatus as recited in claim 1] A total-reflection x-ray fluorescence apparatus comprising:

an x-ray source for providing x-rays;

a doubly-curved x-ray optic for diffracting and focusing the x-rays provided by the x-ray source;

a surface onto which at least some of the diffracted and focused x-rays are directed;

an x-ray detector for detecting resulting x-ray fluorescence emitted by any foreign matter present on the surface; and

wherein the x-ray source and the point of impingement upon the surface define an optic circle of radius R, and wherein the doubly-curved x-ray optic comprises a surface and a plurality of atomic planes of radius RP which intersect the surface at an angle α; and wherein the radius of the atomic planes RP of the doubly-curved x-ray optic is defined by the equation $RP = 2R \cos \alpha$.

51. (New) The apparatus as recited in claim 1, wherein the doubly-curved x-ray optic comprises:

a backing plate having a supporting surface;

an adhesive layer disposed above said supporting surface of said backing plate, said adhesive layer having a minimum thickness x; and

an optical layer disposed above said adhesive layer, said optical layer comprising an optical surface, said optical surface of said optical layer having a desired curvature, and said optical layer having a thickness y, wherein x>y.

52. (New) The apparatus as recited in claim 51, wherein said supporting surface of said backing plate has a curvature, said curvature of said supporting surface being different than said curvature of said optical surface of said optical layer.

53. (New) The apparatus as recited in claim 51, wherein said adhesive comprises an epoxy material, and wherein said optically curved element further comprises a protective layer surrounding an edge of said optical layer such that said adhesive is disposed between said optical layer, with said protective layer surrounding said edge thereof, and said supporting surface of said backing plate.

54. (New) The apparatus as recited in claim 51, wherein said minimum thickness x of said adhesive layer is greater than or equal to 20 μm; and said thickness y of said flexible layer is greater than or equal to 5 μm.

55. (New) The apparatus as recited in claim 51, wherein said optical layer comprises a crystal.

56. (New) The apparatus as recited in claim 55, wherein said adhesive layer is an epoxy, and wherein: x is between 0.1 mm and 1 mm and y is between 10 μm and 50 μm.

57. (New) The apparatus as recited in claim 14, wherein the doubly-curved x-ray optic comprises:

a backing plate having a supporting surface;

an adhesive layer disposed above said supporting surface of said backing plate, said adhesive layer having a minimum thickness x; and

an optical layer disposed above said adhesive layer, said optical layer comprising an optical surface, said optical surface of said optical layer having a desired curvature, and said optical layer having a thickness y, wherein x>y.

58. (New) The method as recited in claim 18, wherein the doubly-curved x-ray optic comprises:

a backing plate having a supporting surface;

an adhesive layer disposed above said supporting surface of said backing plate, said adhesive layer having a minimum thickness x; and

an optical layer disposed above said adhesive layer, said optical layer comprising an optical surface, said optical surface of said optical layer having a desired curvature, and said optical layer having a thickness y, wherein x>y.

59. (New) The method as recited in claim 58, wherein said supporting surface of said backing plate has a curvature, said curvature of said supporting surface being different than said curvature of said optical surface of said optical layer.

60. (New) The method as recited in claim 58, wherein said adhesive comprises an epoxy material, and wherein said optically curved element further comprises a protective layer surrounding an edge of said optical layer such that said adhesive is disposed between said optical layer, with said protective layer surrounding said edge thereof, and said supporting surface of said backing plate.

61. (New) The method as recited in claim 58, wherein said minimum thickness x of said adhesive layer is greater than or equal to 20 μm; and said thickness y of said flexible layer is greater than or equal to 5 μm.

62. (New) The method as recited in claim 58, wherein said optical layer comprises a crystal.

63. (New) The method as recited in claim 62, wherein said adhesive layer is an epoxy, and wherein: x is between 0.1 mm and 1 mm and y is between 10 μm and 50 μm.

64. (New) The apparatus as recited in claim 41, wherein the doubly-curved x-ray optic comprises:

a backing plate having a supporting surface;

an adhesive layer disposed above said supporting surface of said backing plate, said adhesive layer having a minimum thickness x; and

an optical layer disposed above said adhesive layer, said optical layer comprising an optical surface, said optical surface of said optical layer having a desired curvature, and said optical layer having a thickness y, wherein x>y.